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Physics activities

- Recent activities off project
- Recent activities on Project
- Immediate Future – Critical path items for DC
- Future activities

Physics activites

- Lund Workshop (14/100 talks by US people)
  First major exposure of Athena to "user community"

- Impact of staging

- Impact of detector changes
  Bigger gaps in Muon system
  Fully insertable Pixels

- Thoughts about an upgrade
  Study of physics impact of energy and or luminosity upgrades
  Requested by CERN Director General

Lund Feedback – Main points

Code is not availailable outside LBNL, BNL and CERN

Need for same geometry in Simulation and reconstruction In process

Unclear distinction between developer and production releases

Concerns about bookeeping

Complaints about mailing lists and information flow

Unstable environment (SRT/CMT) transition completed

Tutorials are broken Being fixed

Need for event skipping/filtering

Pile up support is needed being worked on

No user documentation on how to use Objy for output being worked on

Upgrade Studies

Physics studies carried out in Summer 2000 and 2001 in response to request from CERN management.

Joint studies with CMS (plus theorists in 2001)

Addressed physics impact of Luminosity and energy upgrades. $28\mathrm{TeV}$ and 10 times design luminosity.

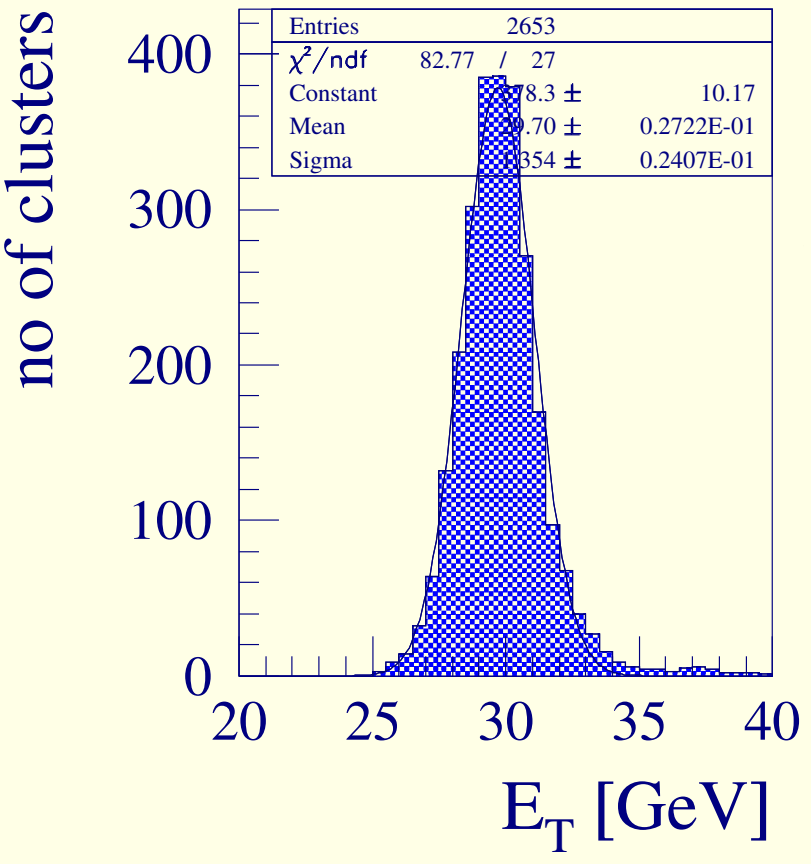
Most activity focused on luminosity upgrade as this is less demanding for the machine and less costly

Ultimate Luminosity of 2.3×10^{34} could be achieved by current design but only in two experiments (ATLAS+CMS)

Detector Performance

Luminosity is much more demanding

LAr calorimeter performance degrades
30 GeV electrons $\frac{\sigma}{E} \sim 2.5\%$ at 10^{34}
$\rightarrow \frac{\sigma}{E} \sim 3.6\%$ at 10^{35}



b-tagging

Rejection factors against u-jets
for 50% b-tagging efficiency

$P_T(\mathrm{GeV})$	10^{34}	10^{35}
25-40	33	3.7
45-60	140	23
60-100	190	27
100-200	300	113
200-350	90	42

e/jet separation: $40\mathrm{GeV}$ E_T

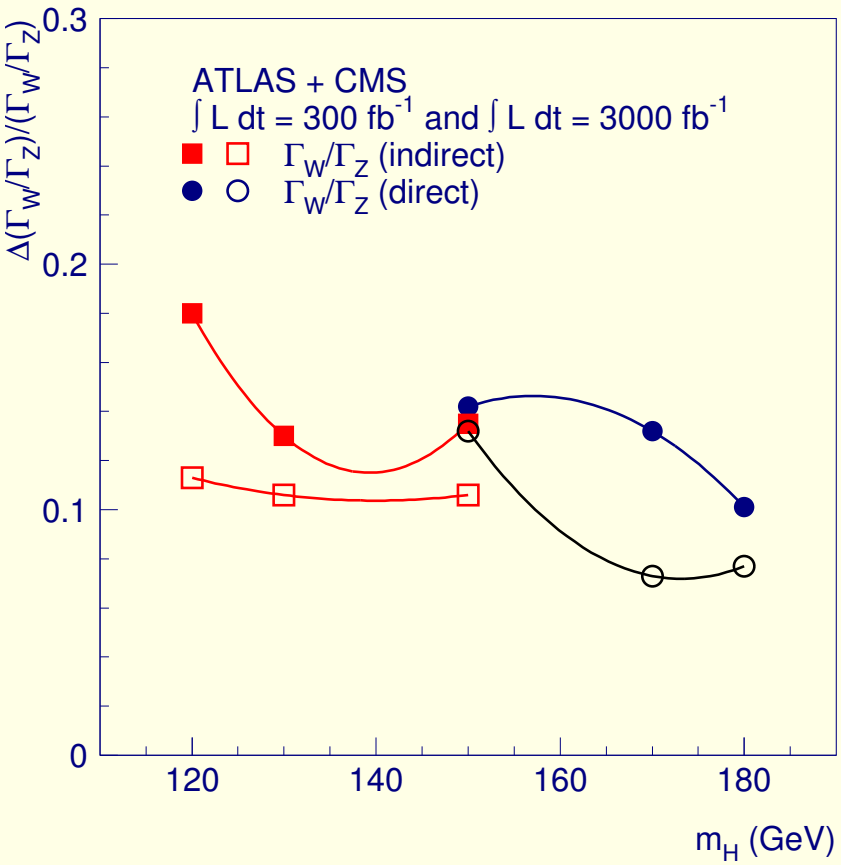
	Electron effic.	Jet Rejection
10^{34}	81%	10600 ± 2200
10^{35}	78%	6800 ± 1130

Measurements of Higgs Couplings

Luminosity upgrade improves precision by up to a factor of two

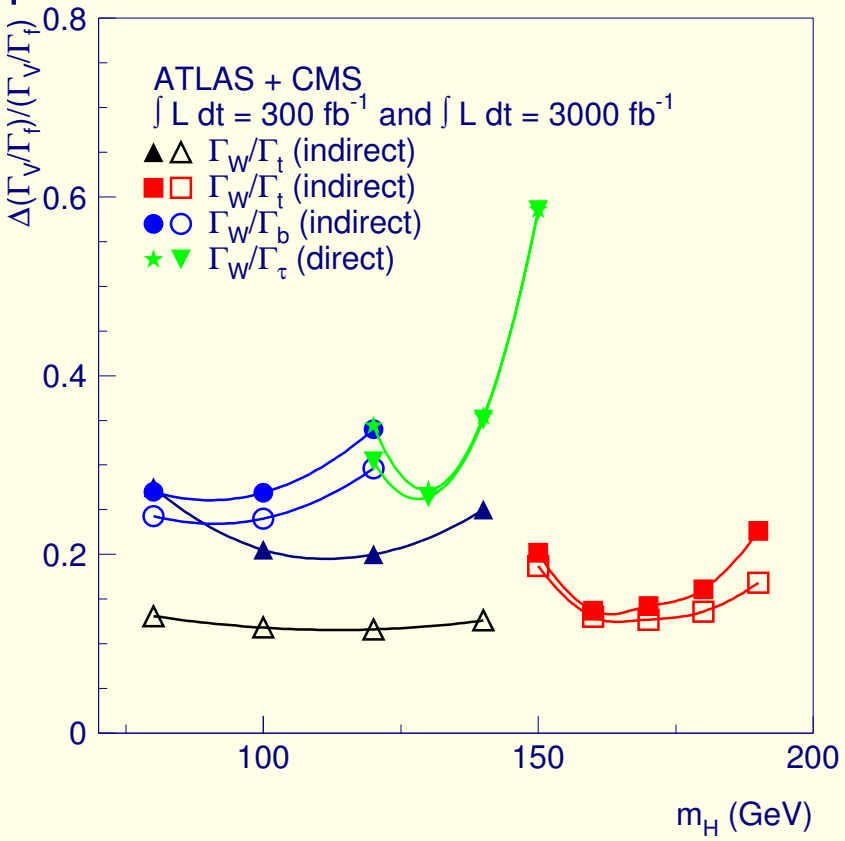
Boson couplings

Measured from $\gamma\gamma$ WW and ZZ decays



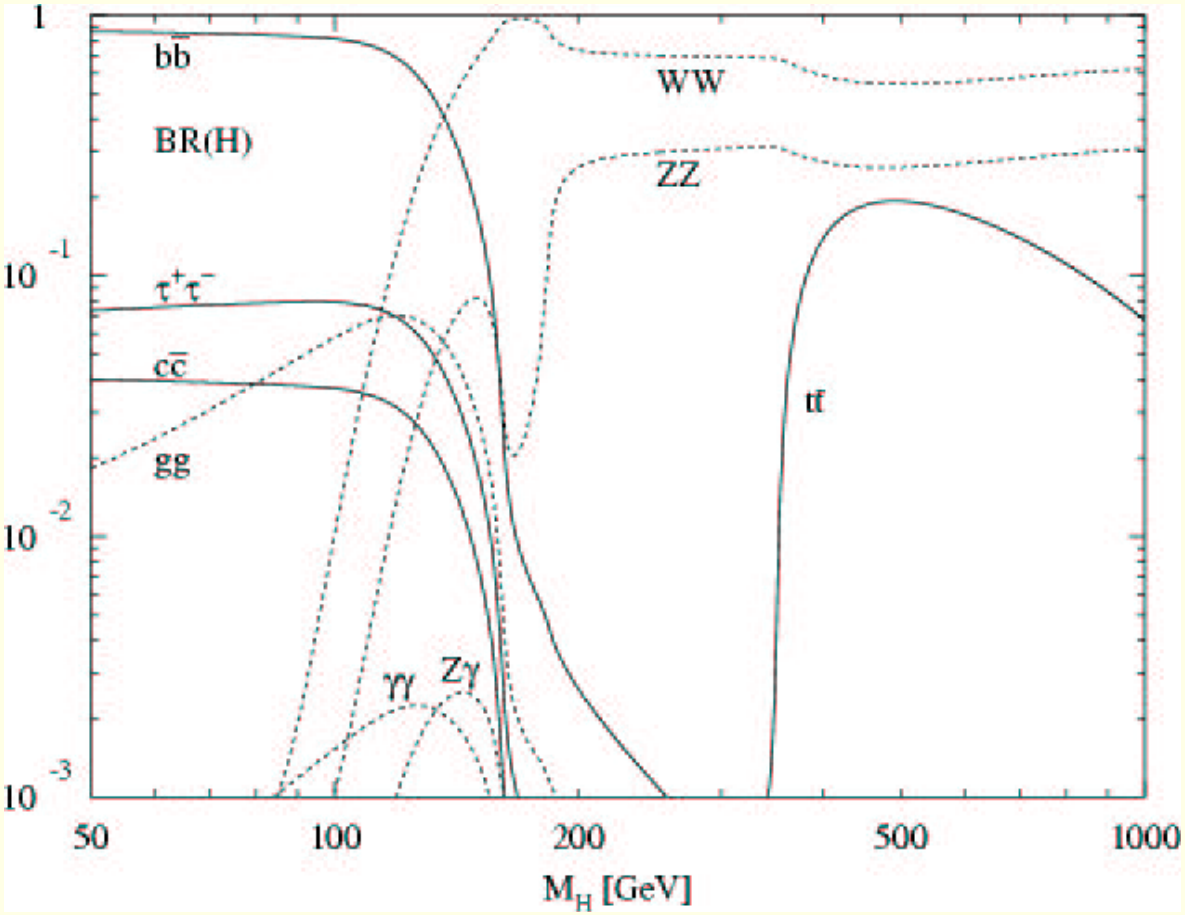
Fermion couplings

Inferred from $\gamma\gamma$ and WW final states and comparison of WH, $t\bar{t}H$ and H production



$H \to Z\gamma$ is with $Z \to \mu\mu$ or $Z \to e^+e^-$ is visible

BR



ATLAS+CMS 600fb^{-1} 3σ; 6000fb^{-1} 11σ

Higgs self coupling??

Preliminary particle level study of HH final states which contains a contribution from λ_{HHH} Very hard to measure anywhere: linear collider folks claim 20% precision.

Event rates for $6000\mathrm{fb}^{-1}$, both total rates and rates from WW fusion studied

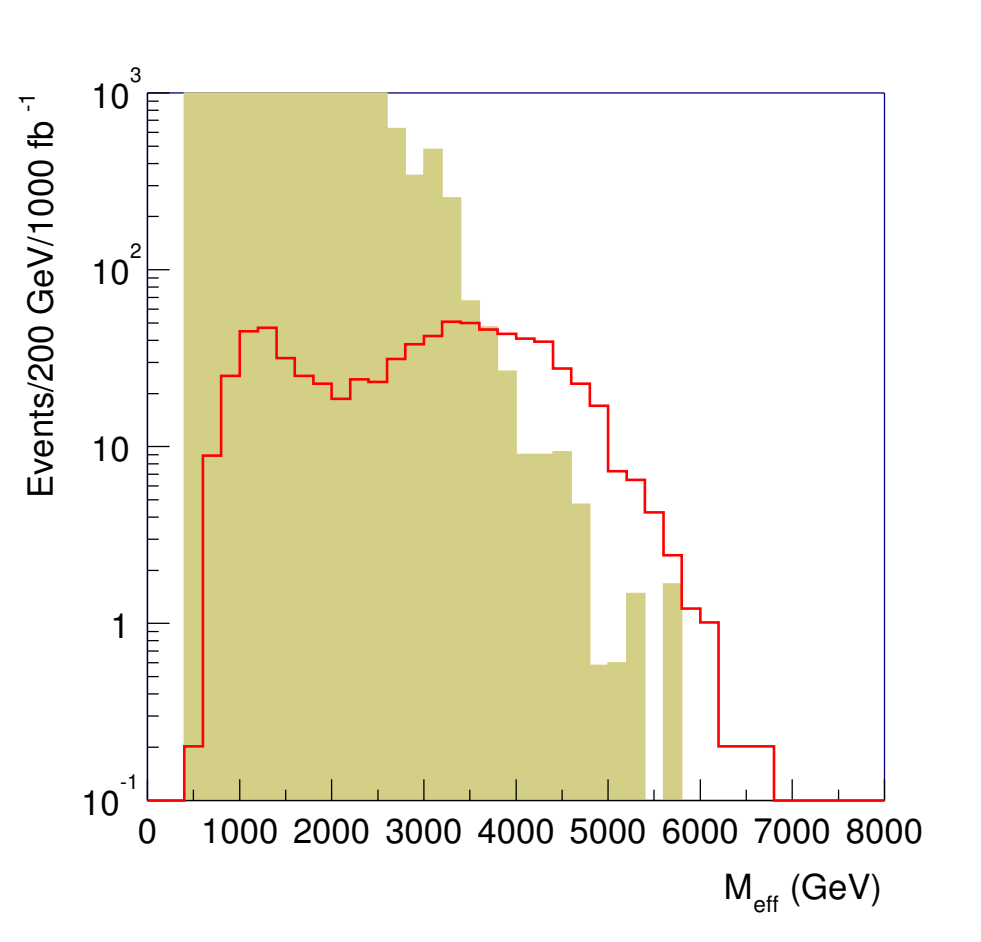
Process	$M_H = 120$	$M_H = 140$	$M_H = 170$
$HH \to 4b$	6000	1000	0.5
$HH \to 2b\ell\nu\ell\nu$	500	650	5
$HH \to 4\ell 4\nu$	10	90	235
$qqHH \to qq4b$	380	70	0
$qqHH \to qq4b$	30	40	1
$qqHH \to qq4b$	0.5	6	15
$t\bar{t}H \to 6b\ell\nu jj$	15	2	0

b-tagging efficiency is vital (50% assumed)

Only a few backgrounds estimated: jet rejection at least 40 is needed

SUSY

$M_{\tilde{g}} = 2.4TeV$
SM is shaded



Mass reach extends by 30% to $3.5\mathrm{TeV}$ for gluinos in case of luminosity upgrade More detailed measurements become possible Note that energy upgrade is more powerful

Critical Items for DC

See GP's talk for more general information

Issues for physics Generation

DC0 is $Z + jet$ (leptonic Z decays only), mainly pythia (ready to go)
Some Isajet and Herwig for comparison

DC1 Jets for HLT/TDR; some "interesting physics" for improved phyiscs studies and testing of analysis model.
Will also use dedicated min-bias generator (phojet) for comparison.

Project activities

Organization

Goal is to integrate Generators so that

All generators present data in the same format to simulation

Parameters are set at runtime

Version switching must be possible

Actual Generators are maintained outside Atlas codebase

Interface packages are part of Athena

See WBS for complete structure

External packages

Each generator exists as an external package
/afs/cern.ch/atlas/offline/external/
allows us to have version control

Linksets from External for ease of use

Pythia 6.129 and 6.157 Exist – Maintained by Stan Thompson

Pythia 7 Maintained by Maya Stavrianakou

Herwig 6.1 Exists – Maintained by I.H. (volunteer needed)

Isajet 7.44 - 7.51 Exist – Maintained by Jim Shank

Taoula/Photos vanilla/CLEO/ALEPH versions Exist – Maintained by I.H. (volunteer needed)

Stdhep 4.07 Maintained by I.H. (volunteer needed)

EvtGen – Maintained by Maria Smizarska

Others need to be there, in particular CompHep, Grace, MADGRAPH, vecbos

These tasks should be spread among many people

Athena Interface

Intererfaces to load events into common format (HepMC) that can be used downstream

Documentation in Generators/GeneratorModules/doc and
http://www-theory.lbl.gov/~ianh/monte/Generators/

Information is presented as a collection of HepMC structures

HepMC is an ATLAS developed product, exported to CLHEP

One interface per Generator. Intefaces are my responsibility at present

Status – Lund Release

Isajet 7.51, Pythia 6.157 supported

Herwig 6.1 available except for SUSY

Pythia 6.129 can be used by simple change (needs recompile, straightforward for Athena users, impossible with tar ball)

GENZ to HepMC converter available (Maria S.), should enable old generators (Pythia 5.7) to feed common format.

Current issues

Inconsistency inside HEPEVT structure causes problems
HepMC requires consistency between mothers and daughters
We are translating into HepMC from the StdHep common (HEPEVT)

The HEPEVT common that is filled from the Generators has some inconsistencies – particles appearing twice, inconsistent mothers and daughters.

CLHEP folks should be fixing this, in meantime we are trying to do it.

Simplest solution is to convert directly from the Generators to HepMC. Eventually there will be a CLHEP tool (I hope)

Simplest would be for Generator authors to maintain the translator as part of the their code. There are HEPEVT translators distributed with the code.

Current Activity

Fix problems reported by users of Lund release

Full support for Herwig 6.3 – Should be in 3.0.0

Restructure of Event store (Storegate) – just done

Tauola integrated (M. Dosil) – (Code exists – 2.5.0)

Move to CLHEP names for HepMC – just done

Integrate Genz reader so that data can be fed to ATLFAST – just done

Converter to produce data in form readable by G3 simulation, Needed for DC0. (O'Neill and Smizarksa, in process)

Interface to feed events to G4 – exists in private area, Leggett

Longer term

Integrate EvtGen – Dedicated B decay package, vital for B-physics group

Improve user interface for parameter querying and setting.

Parton packages, Comphep etc – Discussion with CMS (De Roeck) about this

Conclusions

Dissapointing that CLHEP is moving slowly on HepMC, we are still using ATLAS version.

Just about managed to "stay above water"

Search has started for support person

Take over Interface support

Help manage generation for DC

Should get software agreement once person is hired.